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Commentary

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The original title of Alberto Trejos and Randall Wright's article contained the phrase "A Step Further." This seemed unduly modest: Although Trejos and Wright haven't yet delivered a grand unified theory of international money, they've certainly taken more than one step. Their divisible output model can address a wide range of issues in interesting ways. Even where its answers are not satisfying, they are informative about the drawbacks of this class of models and point future researchers in productive directions.

WHY SEARCH MODELS?

At this stage of their development, search theory models of money are still pretty stilted. Things are not modeled in the most natural way, and results sometimes come from strange places in the model. Thus I think it is important to start by briefly outlining what search theory advocates think they are accomplishing. The dominant general equilibrium paradigm in economics is the Walrasian model, which works like a giant general store with a really smart proprietor. He knows exactly what is in inventory, what is coming in, and what everybody wants. Then he figures out what rates he can trade at (relative prices) to have zero excess demand for everything. And the truly amazing thing is that he works for free; the process of trade does not consume resources. There is not much need for any other sort of institution. In particular there is no need for money.

The basic idea behind search theory models of money is that intratemporal trade is costly. We have a pretty good idea by now of what happens in economies with super-sophisticated Walrasian trading

institutions. But what happens if we go to the opposite extreme? Search theory models start with no trading institutions. People meet each other at random. Maybe they can trade, maybe they cannot, depending on who wants what and who has what. If they cannot trade today, they try again tomorrow. The social contrivance of money, as Samuelson called it, turns out to be very useful in this kind of environment.

This article is in the second generation of search models, which Trejos and Wright (1995) started in a previous paper. A single indivisible unit of money can be traded for a variable quantity of goods. Why not instead allow people to trade a single unit of goods for a variable quantity of money? The simple answer is that it is too difficult. Nobody knows yet how to do it in a very satisfactory way.

Divisible goods models like the one in this article are a clever compromise between the tractable and the ideal. There is a hidden cost to doing things this way, however. Even though we have variable prices, it is very difficult, maybe impossible, to get this sort of model to deliver sustained inflation. With people allowed to carry around only one unit of money, you cannot force per capita money holdings to grow past one, which they must do if per capita money grows at a constant rate. Pretty soon everybody is holding money, and no trade takes place. Thus it is not reasonable to expect steady-state inflation from this class of models.

THE INTERNATIONAL SEARCH MODEL

So now let's look at what we do get here. There are two countries. Inside the countries traders are vibrating around, occasionally crashing into each other. When people crash into one another, sometimes trade is possible. You might have somebody who can produce papayas running into somebody who likes papayas. Barter

will not be possible because preferences are set up in a ring structure. With three goods, producers of papayas like kiwis, producers of kiwis like mangoes, and producers of mangoes like papayas. However, trade might be possible if the guy who likes papayas has some kind of money. In Trejos and Wright's divisible output model the traders play a bargaining game. In earlier work, they studied several kinds of bargaining games. Here they just give all of the gains from trade to the buyer.

The problem that has to be solved by the seller is this: How much will I produce for my country's money and how much for foreign money? I have to think about basically two kinds of things when I make this decision. I know I am going to meet other foreign and domestic producers in the future. How much will they produce in exchange for the different kinds of money? How likely is it that I will run into foreign and domestic producers?

By assumption, if I run into a guy with domestic money, I take it as long as the buyer does not want me to produce too much (which he never does in equilibrium). These kinds of trades always take place in this model.

If I run into someone with foreign money, my problem is more complicated. I need to think about how easy it is to get rid of the foreign money. Of course this depends on how likely it is that I will meet foreigners. But it also depends on what I think other domestic producers will do if I offer them foreign money. This is crucial. If I think that they will produce a lot for me, I will be inclined to produce lots for my buyer. This results in one of the equilibria with international money. If I think that other domestic producers are not very interested in foreign money, neither am I. In this case I am willing to produce only a little for my buyer. He is not willing to make any offer I think is reasonable. So we do not trade. This is the equilibrium with no international money.

It is an important aspect of this model that for many parameter values there are multiple equilibria. In other words, whether you do or do not have interna-

tional money sometimes depends only on those expectations. For some parameters, either, neither, or both moneys can be international. The clearest case in which there is a single equilibrium is when one country is large relative to the other country. Developing models that describe the process by which the economy settles on one equilibrium would be an important advance, in my opinion. Trejos and Wright allude to one possible route when they mention that they are not going to consider monetary policies aimed at influencing which equilibrium prevails.

POLICY

I was particularly glad to see the section on endogenous policy, where the motives of the money issuer are clearly laid out. The authors provide one model for idealists and three models for cynics. There are some satisfying and intriguing results here that the authors do not emphasize. I particularly like one such pair.

First, a reassuring result: Unilateral seigniorage maximization produces lower steady-state welfare than welfare maximization. I would be pretty worried about the model if it produced the opposite result, just as I would be worried if steady states with lots of money delivered more valuable money than steady states with only a little money.

The intriguing twin of that result is the remarkable fact that cooperative seigniorage maximization can dominate noncooperative welfare maximization in welfare terms. What is going on here is that each government's monetary policy generates externalities for the other country. Both countries can be better off if those externalities are internalized in a cooperative arrangement, even if they are cooperating over maximizing the wrong objective.

I do have some reservations about the article's welfare results for several interrelated reasons. First, the optimizing governments are restricted to choosing their policy from among the class of policies that result in constant per capita money. I do

not think anyone believes that a government's seigniorage-maximizing policy is one that produces unchanging prices. If we are serious about seigniorage as a motive for money issue, we will have to build models in which inflation can occur.

My second reservation comes from the two sources of money's real effects in this model. First, money facilitates trade. That is what makes welfare rise at lower levels of M . I have no problem with that. In a way it is the whole point of search models and a compelling story about why societies use money. But what drives welfare down as M rises is a combination of two things. First, producers will not be willing to produce as much, so fewer goods are traded in each match. Second, however, producers are literally crowded out of the market. Everybody is running around with money, so not only are goods expensive, you also have trouble finding them. Putting one more unit of money into circulation means there will be one less producer. This is a rather strained model of the costs of inflation.

My final point on policy is this: One of the beauties of the original Kiyotaki and Wright models is that money crops up more or less endogenously. Nobody is forced to use it. In this model they are forced to use it. There is no other way to accomplish trades. One position on this is that we know money is used in these environments, so why should we go to all the trouble of putting barter into every one of our models? I think it matters here because the possibility of barter would put a constraint on seigniorage maximization. As in the original Kiyotaki and Wright models, traders would have the option of never trading for money. Seigniorage is measured in real terms here, but if barter were an option, the monetary equilibrium could still collapse at a lower level of money than the optimal level in the present model. To make this work you would need to give traders an outside option, call it home production, which gives them a utility floor if they chose not to attempt trade. When money supplies are too high then, the only equilibrium will be barter.

REFERENCE

Trejos, Alberto, and Randall Wright. "Search, Bargaining, Money, and Prices," *Journal of Political Economy* (February 1995), pp. 118–41.